A Speckle Experiment during the Partial Eclipse

S. K. Saha, B. S. Nagabhushana, A. V. Ananth and P. Venkatakrishnan
Indian Institute of Astrophysics, Bangalore 560034

Abstract

An experiment for the speckle reconstruction of solar features was developed for observing the partial eclipse of the sun as viewed from Bangalore on October 24, 1995. No data could be obtained because of cloudy sky but the experimental details are described.

Key Words: Solar speckle, Image Reconstruction, Lunar limb.

1. Introduction

Many problems in solar physics require information about the solar surface features at the highest possible angular resolution. The earth's atmosphere blurs the images. In the case of night-time astronomy, image reconstruction techniques have been developed (Labeyrie, 1970, Knox and Thompson, 1974, Weigelt, 1978), that take advantage of a nearby point source as a reference for the reconstructions. This is not possible for the solar features. The lunar limb provides a sharp edge as a reference object during solar eclipses. A solar speckle experiment was planned for observing the solar eclipse of Oct. 24, 1995 visible as a partial eclipse from Bangalore.

The Instrumentation

A Carl-Zeiss 15 cm Cassegrain-Schmidt reflector was used as the telescope for the experiment. To prevent heating of the optics, an aluminised glass plate was fixed in front of the telescope that reflected back 80 percent of the sunlight and transmitted only 20 percent. A 3 nm passband filter centered at 600 nm was placed after this, followed by another polaroid mounted on a rotatable holder as shown in Figure 1. The amount of light falling on to the camera can be adjusted by rotating the second polaroid. A pin-hole of 1 mm diameter was placed at the focal plane for isolating a small field-of-view. A microscope objective reimages the pin-hole on to the camera.

The camera is a EEV CCD camera operated in the TV mode. The images can be acquired with exposure time of 20 ms using a Data Translation^{TM} frame-grabber card DT-2861 and subsequently stored on to the hard disk of a PC/AT computer.

Result

No images of the partially eclipsed sun could be acquired due to unfavourable weather conditions at Bangalore on Oct. 24, 1995. The image reconstruction involves the treatment of both amplitude errors and phase errors. The 20 ms exposure time is small enough to preserve phase errors. Any of the schemes for phase reconstruction that satisfactorily reproduces the lunar limb would be valid for solar features close to the limb, i. e., within the isoplanatic patch. Also, the limb reconstruction would be valid only for phase distortions along one dimension (in a direction normal to the lunar limb). In spite of these shortcomings, the limb data would have provided additional constraints for techniques like blind iterative deconvolution.

Acknowledgments

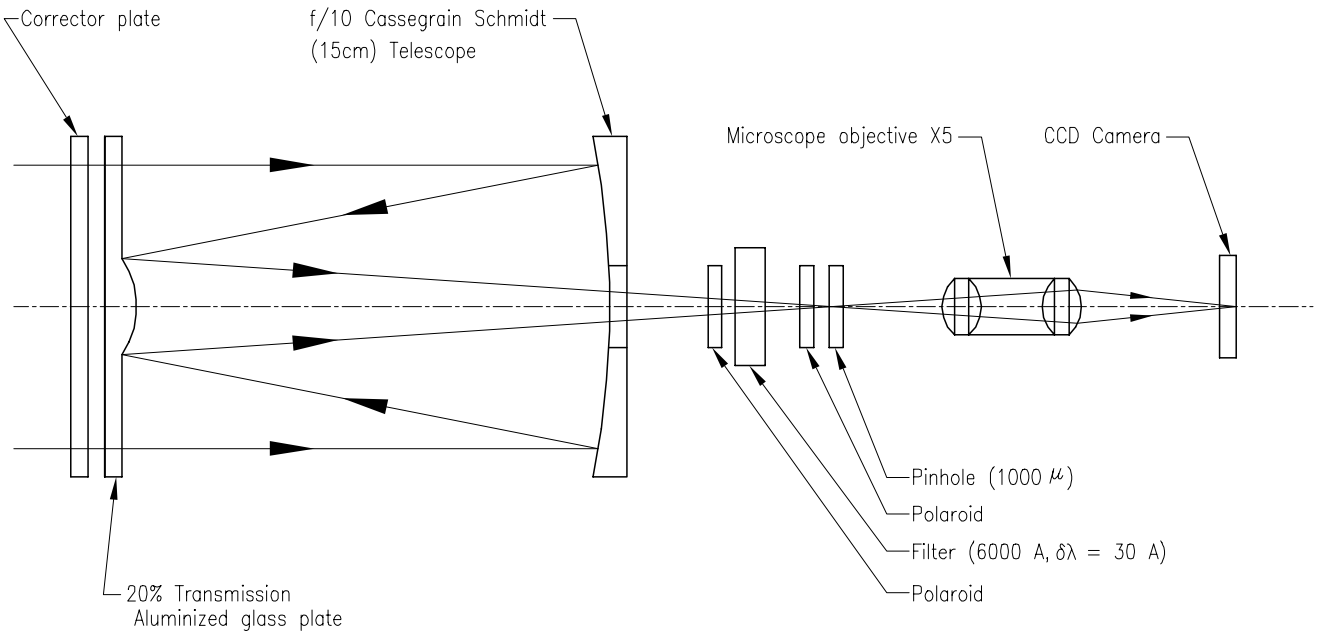
The personnel of Bangalore workshop, in particular Messrs T. Periyanayagam and N. Thimmaiah, provided excellent support for fabricating the instrument. Mr. V. Gopinath of photonics division, Mr. R. M. Paulraj of mechanical design section, Mr. K. Padmanabhan of electrical division, A. S. Babu of Electronics division also helped in various ways. The enthusiastic help rendered by Messers V. Krishnakumar, K. Sankarasubramanian and R. Sreedharan (all Ph. D students) during the testing phase is also acknowledged.

References

Knox K.T. & Thompson B.J., 1974, Astrophys. J. **193**, L45.
Labeyrie A., 1970, Astron. Astrophys., **6**, 85.
Weigelt G., 1978, Appl. Opt. **17**, 2660.

Figure Caption

Figure 1: Schematic layout of the instrument.


Corrector plate
f/10 Cassegrain Schmidt
(15cm) Telescope
Microscope objective X5
CCD Camera
Pinhole (1000 μ)
Polaroid
Filter (6000 A, δλ = 30 A)
Polaroid
20% Transmission
Aluminized glass plate